DOCUMENT RESUME

ED 451 383 CE 081 531

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TITLE Using Telephone and Mail Surveys as a Supplement or Alternative to Door-to-Door Surveys in the Assessment of Adult Literacy. Working Paper Series.
INSTITUTION Education Statistics Services Inst., Washington, DC.
SPONS AGENCY National Center for Education Statistics (ED), Washington, DC.
REPORT NO NCES-WP-2000-06
PUB DATE 2000-03-00
NOTE 60p.
AVAILABLE FROM ED Pubs, P.O. Box 1398, Jessup, MD 20794-1398. Tel: 877-433-7827 (Toll Free). For full text: http://www.nces.ed.gov/pubs2000/20006.pdf.
PUB TYPE Information Analyses (070) -- Reports - Evaluative (142)
EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS Adult Basic Education; Adult Development; *Adult Literacy; Cognitive Ability; Comparative Analysis; *Educational Assessment; Educational Theories; Literature Reviews; *Mail Surveys; Models; National Surveys; Oral Language; Research Methodology; *Telephone Surveys; *Test Validity; Trend Analysis
IDENTIFIERS International Adult Literacy Survey; National Adult Literacy Survey (NCES); Survey Research; Workforce Investment Act 1998 Title II

ABSTRACT

This paper discusses the use of telephone surveys as a substitute for, or addition to, the use of door-to-door surveys in assessing adult literacy ability. Part 1 addresses issues of validity in adult literacy assessment, including the concepts of construct or inferential validity and action or use validity. Part 2 is a review of related research that has used telephone and mail surveys to assess the cognitive abilities of adults. Part 3 discusses the theoretical model of literacy that the National Adult Literacy Survey (NALS) and International Adult Literacy Survey (IALS) have used and how that model can be modified to incorporate a developmental and componential model of literacy that also includes the oral language aspects of literacy given in the Adult Education and Family Literacy Act of 1998. Part 4 addresses several issues about the use of telephone and mail surveys, including concerns about using these survey methods in such a way as to make continuity in trend data from previous surveys of adult literacy possible. Appendixes include 69 references and a summary of an empirical study of the proposition that at a certain stage adults' comprehension of language can be assessed as well by listening as by reading. (Author/YLB)

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Working Paper Series

Using Telephone and Mail Surveys as a Supplement or Alternative to Door-to-Door Surveys in the Assessment of Adult Literacy

Working Paper No. 2000-06 March 2000

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Suggested Citation

U.S. Department of Education. National Center for Education Statistics. *Using Telephone and Mail Surveys as a Supplement or Alternative to Door-to-Door Surveys in the Assessment of Adult Literacy*, Working Paper No. 2000-06, by Thomas G. Sticht. Project Officer, Sheida White. Washington, DC: 2000.

March 2000

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Using Telephone and Mail Surveys as a Supplement or Alternative to Door-to-Door Surveys in the Assessment of Adult Literacy

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March 2000

This project was an activity of the Education Statistics Services Institute.

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Abstract

This paper discusses the use of telephone surveys as a substitute for, or addition to, the use of door-to-door surveys in assessing adult literacy ability. Part 1 addresses issues of validity in adult literacy assessment. Part 2 is a review of related research that has used telephone and mail surveys to assess the cognitive abilities of adults. Part 3 discusses the theoretical model of literacy that the National Adult Literacy Survey (NALS) and International Adult Literacy Survey (IALS) have used and how that model can be modified to incorporate a developmental and componential model of literacy that also includes the oral language aspects of literacy given in the Adult Education and Family Literacy Act of 1998. Finally, Part 4 addresses several issues about the use of telephone and mail surveys, including concerns about using these survey methods in such a way as to make continuity in trend data from previous surveys of adult literacy possible.

Introduction

National assessments of adult literacy have been valued by adult educators because they serve the generally useful purpose of keeping the issue of adult literacy visible to policymakers, business and industry leaders, labor unions, educators and adults themselves, who may be stimulated to seek additional literacy development (Fagan 1994).

Recently, however, the assessment of adult literacy in industrial nations has taken on a new significance (The Organization for Economic Co-operation and Development (OECD), 1995). The OECD notes that, in regard to concerns for economic competitiveness among member nations, "... one area that is receiving growing attention from educational policymakers and analysts in a number of OECD countries is the direct measurement of literacy levels in the labor force of industrialized countries" (Benton and Noyelle 1992, 11). Indeed, results of the first International Adult Literacy Survey (IALS) involving some ten member nations of the OECD have recently been reported (OECD 1995, 1997).

Despite their usefulness to adult educators and policymakers, the cost involved in conducting adult literacy surveys is a matter of some concern to these same groups. In the United States, the National Adult Literacy Survey (NALS) (Kirsch, Jungeblut, Jenkins, and Kolstad 1993), conducted by the National Center for Education Statistics (NCES) of the U.S. Department of Education cost over $14 million for the national and state samples involved (A. Kolstad—personal communication, April, 1994). When asked at a planning meeting for the National Assessment of Adult Literacy (NAAL), state directors of adult literacy education who were present reported that "...it would be more difficult to find the funds for another round" (U.S. Department of Education 1998, 5).

The Search for Lower Cost Methods for Representing Adult Literacy

The NALS of 1992 assessed adult literacy by personal interviews using door-to-door sampling. Interviewers asked adults to perform tasks such as filling in a bank check, locating times for travel on a train schedule, calculating the cost of a meal in a restaurant, and other types of "tasks that simulate the literacy demands that adults encounter in their daily lives" (Campbell, Kirsch, and Kolstad 1992, 12).

To avoid the costs of door-to-door assessments, the U.S. Department of Education has also used statistical regression techniques, based on data from the National Adult Literacy Survey, to estimate the literacy levels of adults in states that did not participate in the national survey (Reder 1994(a)). In Canada, too, concerns about the cost of administering direct assessments of adult literacy led the Department of the Secretary of State in Ottawa to explore the use of *proxy* measures of adult functional literacy to predict the direct assessment data (Neice, Adsett, and Rodney 1992).

Statistical techniques and proxies for literacy assessment are of limited educational use when they include variables such as ethnicity and gender (Reder 1994(a)) or learning disabilities and mother's educational level (Neice, Adsett, and Rodney 1992) in estimating people's literacy skills. These variables are not amenable to change by education or training and hence recommendations for action in the form of educational interventions are not feasible.

In a planning meeting for the NAAL, to be conducted in 2002, it was suggested that telephone interviews might be considered as a cost-reducing method for characterizing aspects of adult literacy (U.S. Department of Education 1998, 9, 17). Presently, the National Center for Education Statistics conducts biennial telephone surveys of adults to determine their participation in adult education, the types of education they engage in, and so forth. So the requisite sampling and telephone survey methodologies are familiar to NCES and it is well recognized that telephone survey methods are much less costly than door-to-door surveys (Chandler 1994). However, there was disagreement at the NAAL planning meeting about whether telephone interviews are a viable means for identifying whether people can "read, write, and comprehend" (17).

Purpose and Plan of the Present Paper

One outcome of the planning meetings for the 2002 NAAL was the suggestion that a paper be commissioned to discuss the feasibility of using telephone surveys as a substitute for or addition to the use of door-to-door surveys in assessing adult literacy ability (U.S. Department of Education 1998, 9). That is the primary purpose of the present paper.

The paper includes the consideration of the use of mail surveys along with telephone surveys as methods that are lower in cost than door-to-door interviewing for assessing adult literacy abilities.

Part 1. Issues of Validity in Adult Literacy Assessment. The first part of the paper addresses issues of validity that have arisen in discussions of national assessments of literacy. This includes a discussion of *construct* or *inferential validity* and the role of convergent and discriminant evidence in establishing the validity of a theory of literacy. It also includes a discussion of the concept of *action* or *use validity* (Messick 1989). This discussion of validity sets the stage for a later discussion in Part 4 of the paper, which includes a comparison between a telephone survey approach and the NALS door-to-door approach in producing informational products deemed useful by policymakers who have supported these large-scale assessments.

Part 2. Review of Related Research. The second segment of the paper provides a review of published studies that have used telephone and mail surveys to assess the cognitive abilities of children or adults. The research reviewed includes the assessment of "intelligence" ("*g*") in studies of behavioral genetics, verbal "aptitude" in studies of personnel testing for selection of qualified applicants for military service, and two studies of adult literacy using telephone and mail surveys.

Part 3. A Cognitive Theory of Literacy. The third section of the paper includes a discussion of the theoretical model of literacy that the NALS and International Adult Literacy Survey (IALS) have used. It discusses how that model can be modified to incorporate a developmental and componential model of literacy that also includes the oral language aspects of literacy given in the Adult Education and Family Literacy Act (AEFLA) of 1998:

> The term 'literacy' means an individual's ability to read, write, and speak in English, compute, and solve problems, at levels of proficiency necessary to function on the job, in the family of the individual, and in society (page H6636).

To *speak* in English also implies the ability to *listen* to and comprehend English. The importance of these oral language aspects of literacy (i.e., speaking and listening to comprehend the English language) to the learning and use of the written English language by native and foreign speakers alike is emphasized in the AEFLA, which stresses the importance of phonemic awareness and phonics in the literacy development of adults in six different sections of the law. The purpose of phonemic awareness and phonics training is to make it possible for a person to comprehend the written representation of the English language through reading with the same or greater

effectiveness and efficiency as the oral representation of the English language can be comprehended by listening. The theoretical model of literacy developed in Part 3 incorporates these various oral and written language constructs.

Part 4. Issues in the Use of Telephone and Mail Surveys in Assessing Adult Literacy. The final part of the paper addresses several issues concerning the use of telephone and mail surveys, including concerns about obtaining representative samples and about using these survey methods in such a way as to make continuity in trend data from previous surveys of adult literacy possible. The feasibility of continuity in such NALS and IALS categories of information as literacy practices, intergenerational transfer, economic indicators, civic participation, and various demographic information products by telephone/mail surveys is explored.

Part 1. Issues of Validity in Adult Literacy Assessment

How should the literacy abilities of adults be represented? When discussed as a form of human cognitive ability, as in the NALS and IALS, literacy is a psychological construct and as such "levels" of literacy cannot be "directly measured" as suggested might be done in the 1992 report from the OECD. In fact, there are no "literacy levels" to be directly measured in the adult labor forces of nations. Instead, there are various ways of construing the nature of literacy and different procedures of measurement that can lead to the construction of alternative *representations* of adult literacy in society.

In the United States over the last seventy-five years, different representations of adult literacy have been socially constructed by psychometricians, statisticians, and survey experts in consultation with various stakeholder groups including adult educators, adult students, literacy researchers, policymakers and others with a declared interest in adult literacy (Sticht and Armstrong 1994). For instance, the National Assessment of Educational Progress of 1970–71 assessed adult literacy using the same "academic" tasks that were used with school children, such as knowledge of word meanings (vocabulary), using visual aids, following written directions, using reference materials, locating significant facts, getting the main idea from materials, drawing inferences, and critical reading.

The Young Adult Literacy Survey (YALS) of 1985, the NALS of 1992 and the IALS of 1995 are the most recent representations of adult literacy at national levels. These surveys assessed adult literacy using "tasks that simulate the literacy demands that adults encounter in their daily lives" (Campbell, Kirsch, and Kolstad 1992, 12).

Similar "real world" tasks were used earlier in the "Survival Literacy" survey by Louis Harris Associates in 1970, the Adult Functional Reading Study of 1973 and the Adult Performance Level Study of 1975 (Sticht and Armstrong 1994).

The fact that assessments of adult literacy over the decades have constructed various representations of adult literacy ("academic," "real world") raises important questions. Just how should the literacy abilities of adults be represented? Are all representations equally valid? Such questions seem to underlie the concern among participants at the NAAL planning meeting mentioned earlier on whether telephone interviews are a viable means for identifying whether people can "read, write, and comprehend."

Yet, even setting aside the concerns about whether telephone surveys can validly represent the literacy abilities of adults, the validity of the general practice of governments in conducting large scale assessments of people's literacy skills has not gone unchallenged. For instance, Kazemek (1990) stated:

> ...attempts at defining "ability levels" and "norms" are not only futile but potentially dangerous as well. How can we possibly arrive at acceptable definitions of literacy when there are countless life goals, needs, and desires among the adult populations? Realistically we cannot, but in our attempts to do so we usually produce reductive lists, scales, and criteria...which are then used to categorize large segments of the population, often in detrimental ways. (56). (See also papers in Venezky, Wagner, and Ciliberti 1990).

Kazemek's questioning of the validity of large-scale assessments of adult literacy in terms of both the way one defines and measures literacy and the way one uses the scores from such assessments raises concerns addressed by Messick's discussions of validity (1989, 1988). Messick discusses validity as a "unified concept" with different facets in which the validity of an assessment refers to the validity of the inferences one makes from the data.

One facet of the validity of test scores is the traditional concept of *construct validity*. Messick refers to this as the validity of interpretive inferences and states:

> To validate an *interpretative inference* [italics added] is to ascertain the extent to which multiple lines of evidence are consonant with the inference, while establishing that alternative inferences are less well supported. This represents the fundamental principle that both convergent and discriminant evidence are required in test validation (1989, 5).

Evidence of convergent validity arises when correlations of literacy scores are found with other variables (e.g., years of education, amount of reading) and when these relationships are predicted by the theory of literacy underlying an

assessment. Evidence of discriminant validity arises when variables that the theory of literacy predicts should not be related are, in fact, unrelated in the data.

Kazemek's questioning of the definitions and operations used to assess adult literacy is a challenge to the construct or interpretative validity of the assessments. His questioning of the uses of test scores, including detrimental uses, is addressed by Messick in the facet of validity that he calls *action* or *use* inferences. He states, "To validate an *action inference*[italics added] requires validation not only of score meaning but also of value implications and action outcomes, especially of the relevance and utility of the test scores for particular applied purposes and of the social consequences of using the scores for applied decision making." (1989, 5).

In the present paper, evidence for *action* validity is evaluated in Part 4 through the comparison of telephone and door-to-door surveys as a means for producing information products about adult literacy valued by the U.S. Congress, the branch of government that requested the NALS in federal legislation.

Some Issues of Validity in the NALS and IALS

In the United States, despite strongly held doubts by some scholars regarding the feasibility of defining and assessing adult literacy, as indicated above, the U.S. Congress passed the Adult Education Amendments of 1988 that required the U.S. Department of Education to submit a report to Congress on the definition of literacy and then to report on the nature and extent of literacy among adults in the nation (Campbell, Kirsch, and Kolstad 1992).

With the aid of a national Advisory Board, the NCES agreed to define literacy as "Using printed and written information to function in society, to achieve one's goals, and to develop one's knowledge and potential." (Kirsch, Jungeblut, Jenkins, and Kolstad 1993, 2-3).

The Advisory Panel for the NALS also agreed on the definitions of three different literacy scales that were developed to represent the literacy skills of adults. These included: prose literacy—the knowledge and skills needed to understand and use information from texts; document literacy—the knowledge and skills required to locate and use information contained in materials; and quantitative literacy—the knowledge and skills required to apply arithmetic operations embedded in printed materials (Kirsch, Jungeblut, Jenkins, and Kolstad 1993). These same definitions were used to assess adults' literacy abilities in the IALS (OECD 1995).

It should be noted that in both the NALS and the IALS there was an important conceptual shift in going from the general definition of literacy as "using printed and written information to function in society, etc." to the definition of the three literacy scales that were actually going to be used to characterize adult literacy in the various countries. None of the definitions of the three scales started with "using printed and written information" as the defining aspect of literacy. Rather all three definitions referred to the psychological constructs of "the knowledge and skills" or "the ability" required to perform tasks using prose, document, and quantitative materials. This makes an important shift in conceptual understanding that, unlike what the general definition of literacy stated, literacy is not the *use* of printed materials per se, but rather the *knowledge and skills* or *ability* that make possible the use of printed materials for various purposes.

A recent U.S. General Accounting Office reported that one expert on adult literacy research stated that functional literacy tests like those of the NALS and IALS may lack validity because they are not derived from theoretical models of ability but from everyday literacy tasks (U.S. General Accounting Office 1995, 24). Given the complex nature of such tasks, it is not clear what implications can be drawn from the test performance.

This was clearly illustrated in a manual for item writing produced by the Comprehensive Adult Student Assessment System (CASAS), an adult literacy assessment system widely used in the United States and in some other industrialized nations that uses "real world" literacy tasks much like those of the NALS and IALS. The manual notes that the use of complex, "real world" or "functional" tasks as items "*...generally tests the use of two or more skills* [italics added]. Therefore, this context is not appropriate in itself for diagnosing weaknesses in specific skills since it is difficult to determine which skill was performed incorrectly" (CASAS 1983, 1).

In the absence of a clearly specified theory of "literacy" as a psychological construct, it is not possible to know how to develop assessments that measure the component knowledge and skills that make-up the ability or abilities that constitute "literacy." Without knowing what specific knowledge or skills are being assessed in "real world" tasks, it is not clear to what extent test performance reflects literacy ability or some other abilities, such as problem solving, reasoning, language comprehension, vocabulary knowledge, management of test-taking anxiety, interpersonal skills, or some complex, interactive combination of all these. That is why, in the earlier version of the NALS and IALS, referred to here as the YALS, performance on the three literacy scales was referred to as "complex information processing" tasks (Kirsch and Jungeblut 1986).

This problem of interpreting what is being measured may not be so important for those who perform well, and can therefore be assumed to possess whatever knowledge and skill is called for in performing the "complex information processing" (literacy?) tasks. The problem becomes critical when the focus of concern is on understanding why it is that those who do not perform well do not perform well. What kinds of services should be provided to help them improve their ability to perform these kinds of tasks? Should major efforts go into providing basic phonemic awareness or phonics training, or should vocabulary development and reading comprehension be the focus of instruction? Should there simply be practice in performing a wide variety of complex, information processing tasks like those assessed on the literacy surveys? How many of such tasks should be used in training and how and why would specific task training be expected to generalize to other tasks? Would training in memory enhancing techniques, logical reasoning, and critical thinking be the thing to do? How much of the problem is a "literacy" problem in contrast to a "general education" problem?

The lack of a good, workable theory of literacy has led to the development of adult literacy assessments over the last three decades using a variety of different materials and tasks. Most recently the NALS and IALS have used three different but highly correlated scales (around r = .90, (Reder 1994(a); Rock 1998)) that produce much redundant information. If a theory of literacy could help identify the "knowledge and skills" that underlie the performance of prose, document and quantitative tasks it might be possible to more directly and cost-effectively assess that knowledge and those skills and to predict the performance of a wide variety of both "academic" and "real world" literacy tasks that go beyond those used in present assessments.

While it is not possible at the present time to provide a comprehensive theory of literacy that is universally agreed upon by all concerned, Part 3 of this paper provides aspects of a cognitive theory of literacy that suggests some of the major components involved in literacy that might be assessed not only in door-to-door surveys, but also in telephone and mail surveys.

Part 2. Review of Related Research

Cognition; Cognitive (adjective): (1) The mental process or faculty by which knowledge is acquired; (2) that which comes to be known, as through perception, reasoning, or intuition; knowledge. (The American Heritage Dictionary 1976)

The definition given above indicates that cognition includes (at least) two aspects: (1) the *mental processes* by means of which knowledge is acquired and (2) the *knowledge* that has been acquired. Telephone surveys have been used to obtain information about both aspects of cognition, the mental processes that people use and the knowledge that people possess. Three such studies are reviewed here.

Assessing Specific and General -'g'- Cognitive Abilities Using Telephone and Mail Surveys

In studies of behavioral genetics, Plomin and associates (Kent and Plomin 1987; Plomin et al. 1986) used mail and telephone surveys to assess various cognitive abilities of children, adolescents and adults (ages 9 to 80). Across the three studies, the tests assessed various verbal, spatial, perceptual speed, and memory abilities. The general procedure in three different studies (two reported in Plomin, et al. 1986) was to first mail out kits containing cognitive test batteries to individuals who had agreed to participate in the studies. Then the test administrator would telephone the subjects and administer the tests over the telephone.

To check for comparability between telephone and face-to-face testing, Kent and Plomin (1987) administered face-to-face assessments to samples of the two hundred and twelve children and adolescents in their study. Fourteen were tested face-to-face before the telephone assessment and sixteen after the telephone tests. Additionally, thirty-two individuals had been tested earlier in telephone sessions and they provided test-retest information for the telephone assessments. Altogether then, there were sixty-two subjects with test-retest scores.

Data showed correlations among telephone and face-to-face samples of over .92 for a *g* (general ability) factor extracted from the factor analysis of scores. Overall, for the total of 62 test-retest scores, correlations were .81 for the Verbal factor, .73 for Spatial, .82 for Perceptual Speed, .57 for Memory, and .79 for *g*.

Kent and Plomin (1987) state that, "These studies indicated that it is possible to assess cognitive functioning via telephone; importantly, subjects indicated that they preferred telephone testing to face-to-face testing, citing increased anxiety during in-person testing" (392).

Testing Word Knowledge by Telephone to Estimate General Cognitive Aptitude Using Computer Adaptive Testing

Research by Legree, Fischl, Gade and Wilson (1998) aimed to determine whether word knowledge (vocabulary) could be assessed over the telephone to predict scores on the Armed Forces Qualification Tests (AFQT), a paper and pencil battery of tests used to select applicants for military service.

Earlier research had produced the Computerized Adaptive Screening Test (CAST) to help U.S. Army recruiters quickly estimate the cognitive aptitude of potential recruits so they could concentrate their time on those individuals most likely to qualify for service. The CAST is highly correlated (.91) with the AFQT and requires about 10 to 15 minutes for administration. This contrasts with the approximately three hours needed to take the Armed Services Vocational Aptitude Battery (ASVAB) from which the AFQT is derived using four sub-tests of the battery.

The CAST uses a computerized adaptive testing program to select items from a large bank of items on the basis of the individual's current level of performance. Using this program, performance on the AFQT is estimated with approximately 10 items from the verbal (word knowledge) domain and 5 from the quantitative domain.

To determine whether the CAST verbal items could be given by telephone to yield an estimate of psychometric *g* (general ability) and AFQT scores, the CAST verbal items consisting of multiple-choice, word knowledge questions requiring recognition of synonyms was administered over the telephone to 144 recruits who had recently enlisted but had not yet entered into the military. The use of new recruits meant that their paper-and-pencil ASVAB/AFQT scores were available from their official records and could be used to determine correlations among the telephone and CAST determined vocabulary knowledge scores and the AFQT scores.

Subjects were called by experienced telephone interviewers who explained the purpose of the study and requested the subject's participation. The interviewer read each question and response alternatives (e.g., The word *tall* means: heavy, large, small, high). Subjects indicated their choice for each item and the interviewer entered the choice into a computer and the program then selected the next item. The branching algorithm selected 10 or 11 items for each subject in arriving at an estimate of the AFQT score.

Data analyses indicated that the telephone and CAST test scores correlated .66 with the AFQT. Because range restrictions due to military entrance requirements attenuates all ASVAB correlations, a bivariate correction for range restriction was used to estimate the correlation between the AFQT and the telephone CAST scores for the general population and this produced a correlation of .81.

Based on the results of the study, the U.S. Army Research Institute is incorporating the Telephone Test into a larger research-based telephone survey addressing issues related to youth career selection to link individual differences in cognitive aptitude to other variables.

The research will also explore the use of the Telephone Test with a broader range of abilities, with particular interest in lower aptitude groups.

Assessing Adult Literacy-Based Knowledge and Literacy Practices by Telephone

In a study using random-digit dialing telephone sampling techniques, Sticht, Hofstetter and Hofstetter (1996) assessed various aspects of adults' literacy-based knowledge and use of printed materials at home and on the job.

Defining Literacy-Based Knowledge. Several lines of research have converged suggesting that people become highly literate largely by engaging in numerous literacy practices, such as reading books, magazines, newspapers, and so forth (Reder 1994(b); Krashen 1993). A review of the major assessments of adult literacy in the United States since 1937 consistently revealed that as years of education increases there are corresponding increases in both the number of literacy practices in which adults engage and the amount of skill displayed in the assessments (Sticht and Armstrong 1994).

In an illuminating program of research, Stanovich and associates explored how the extent of engagement in literacy practices by children and adults contributed to their development of literacy and, more broadly, "verbal intelligence" (Stanovich 1993; Stanovich and Cunningham 1993). Using an innovative method for assessing knowledge with checklists calling for a simple "yes" or "no" judgment on the part of the reader, Stanovich and associates demonstrated that performance on these checklists correlated significantly with a variety of literacy activities and cognitive assessments (Allen, Cipielewski, and Stanovich 1992; West, Stanovich, and Mitchell 1993).

A major conclusion from this body of research is that the simple checklists assess knowledge indicative of (1) the *extent of use* that one makes of printed and written materials, (2) the *knowledge* one derives from the use of these materials, and (3) the *added potential* for engaging in future literacy practices as a consequence of having a broader base of knowledge prerequisite for wide-ranging reading.

In these studies, Stanovich and associates argue that individuals who read a lot acquire, mostly through incidental learning, a large declarative knowledge base containing the names of authors, magazines, newspapers, persons known for their contributions to film, theatre, music and other activities that Hirsch (1987) referred to as "cultural literacy" and a large vocabulary of words typically not encountered with high frequency in day-to-day oral communication nor on television or radio. Scores on these checklists are indicators of both the amount of reading in which individuals engage and of the cognitive outcomes in terms of the individual's declarative knowledge base (see comments by Taylor 1994 and reply by Stanovich and West 1994, regarding contrasting perspectives on the use of the checklist methodology for studying reading behavior).

Using the Stanovich Checklists to Assess Literacy-Based Knowledge by Listening on the Telephone. The checklist approach to knowledge assessment developed by Stanovich and associates lends itself readily to the assessment of knowledge by listening since, as suggested by the developmental model, below, research indicates that, beyond the period of reading in which early decoding skills are developed, listening and reading converge on the same knowledge base (Sticht et al. 1974; Sticht and James 1984; Stanovich 1991; Sinatra 1990). The theory that both listening and reading share the same knowledge base in the human cognitive system (see below), which is made-up of both language (grammar, with lexicon and syntax) and language-based meanings, means that in individuals, after reading decoding processes are developed, the processes of listening and reading are very largely the *same* at the level of the knowledge base (Sticht 1978; Sticht and McDonald 1992). In the individual's mind, listening and reading processes are not *correlated*; rather, they are structurally the same with regard to the knowledge base that they draw upon (with only slight differences due primarily to the nature of the informational displays involved in speaking and writing).

Because individual differences exist in the amount of knowledge that individuals possess, listening and reading will tend to be moderately to highly correlated in the adult population, meaning that low, medium and highly knowledgeable adult listeners will also be low, medium and highly knowledgeable readers (Sticht, Hooke, and

Caylor 1981(a)). The correspondence of listening and reading processes at the level of the knowledge base forms the mechanism for assessing the knowledge component of literacy by telephone.

Knowledge as an Indicator of Literacy Ability. There is a knowledge component (words, sentences, paragraphs) in all of the myriad literacy tasks in which people engage in our information age society. This suggests that the knowledge component can be used as an indicator of literacy ability. The assessment of knowledge as distinct from the performance of complex tasks that include knowledge along with various types of information processing tasks of unknown qualities is also warranted when the definition of literacy adopted by the advisory panel of experts for the NALS is examined. The definition of literacy agreed to was "Using printed and written information to function in society, to achieve one's goals, and to *develop one's knowledge* [italics added] and potential" (Kirsch et al. 1993, 2-3).

The importance of knowledge in literacy was also acknowledged by the NALS advisory panel in its acceptance of the definitions of the three different literacy scales (prose, document, quantitative) that were developed. In each case, literacy was defined as "the knowledge and skills" needed to perform the three types of literacy tasks. From these definitions, it is clear that the advisory panel for the NALS understood that the use of printed and written information to accomplish tasks requires certain knowledge and skills to make such use possible.

In a telephone survey methodology, a respondent's knowledge may be assessed using Stanovich-type lists containing discrete items, such as names or single vocabulary words, that require only a yes/no decision for each item. Such lists are suitable for presentation by telephone for listening and by written checklists for reading because they do not overload working memory (see the human cognitive system model, below) and introduce irrelevant task variance (Messick 1989). In contrast, the NALS used literacy tasks that emphasized "search and locate" (Guthrie, Britten, and Barker 1991) information processing skills requiring subjects to hold instructions in working memory while performing search and locate actions and problem solving (make inferences; reason) to accomplish unfamiliar tasks (Kirschet et al. 1993; Mosenthal and Kirsch 1991; Kirsch and Mosenthal 1990).

NALS data for adults above age 54 show a rapid decline of performance (Kirsch et al. 1993). Since it is well established that working memory becomes increasingly less efficient with advanced age (Bernstein et al.1988; Meyer, Marsiske, and Willis 1993), these findings strongly suggest that the NALS and IALS tasks derive a great deal of their difficulty from the load they place upon working memory and this may threaten their validity as literacy

measures for the elderly. Additionally, the NALS methodology introduces unknown, and possibly irrelevant test variance which may lead to serious underestimations of the breadth of materials that older adults can read and comprehend using their knowledge base and the tasks they can perform in working memory given sufficient time to study materials, without the pressure for efficiency typical of test-taking situations. The latter are of questionable ecological validity in the lives of most adults over the age of 25 who are not in school.

Questions for the present study. This study investigated the assessment of the knowledge component of adult literacy using telephone interviews with five hundred thirty-eight randomly selected adults, all English speakers, as the mode of presentation, listening as the mode of reception, and four abbreviated versions of the Stanovich checklists to assess aspects of the declarative knowledge base likely to be developed by reading. The checklists assessed adults' knowledge of authors, magazine titles, famous people, and vocabulary. In addition to the telephone survey, a sub-sample of one hundred forty adults who agreed to complete a mailout version of the various checklists and a cloze test of reading was surveyed. Several questions that were explored are listed below along with the relevant findings.

1. *Does an oral presentation of checklists by telephone, which requires listening ability, produce results consistent with a written presentation of the checklists, which requires reading ability?*

Yes, data for the telephone and mailed surveys revealed positive relationships between listening and reading ($r=.80$ for Total literacy scores made-up of the summed percentage correct across the four checklists).

2. *Do the knowledge scores obtained using the checklist and telephone survey methodology correlate with scores on another frequently used method for assessing reading ability?*

Yes, both the listening and reading checklist scores were positively and significantly ($r=.38$, $p<.05$) related to the cloze test with its greatly differing task demands and limited content (only one passage was used). These data, along with the data for the first question, provide evidence for the construct or interpretive validity (Messick 1989) of the theory of literacy that states that both listening and reading tap a common knowledge base and that the knowledge base is a component of, not a proxy for, literacy (reading, in this case).

3. *Do the knowledge checklist scores from the telephone survey show positive relationships with demographic variables that have been found in previous adult literacy assessments?*

Yes, convergent evidence for interpretive validity was found in a positive manifold of statistically reliable correlation coefficients among the literacy knowledge checklists and other variables that are interpretable in relation to the development of literacy, such as parent's education, one's own years of education, amount of engagement in various reading practices, occupational status and income.

4. *Are the knowledge checklist scores from the telephone survey negatively correlated or uncorrelated with variables that the construct of literacy encompasses?*

Yes, discriminant validity was evidenced by data indicating that checklist scores were negatively correlated with age and the practices involved in family literacy (e.g., reading to children) which reflects the large proportion of older adults in the telephone sample whose children are grown and gone, yet whose literacy practices in other areas have tended to make them more literate (knowledgeable).

This confirmatory evidence of construct validity for the checklist and telephone methodologies as measures of the knowledge component of literacy is encouraging given that this was the first study of its kind and no attempt was made to develop checklists or cloze tests that would provide greater differentiation among people.

Domain Specific Knowledge Assessed by Telephone. In a second study of the assessment of adults' knowledge by telephone, Hofstetter, Sticht and Hofstetter (1999) used six different checklists of knowledge, five that assessed adults' domain specific knowledge of political information, such as famous political figures and various political policies, as well as a sixth checklist made up of the vocabulary checklist used in the earlier study. A random-digit dialing telephone survey of six hundred thirty-two English speaking adults provided data to study relationships among domain specific knowledge, general vocabulary knowledge, amount of reading reported, occupational status, income and participation in political activity.

As in the first study, a positive matrix of significant correlations was found among literacy practices (amount of reading in home and work settings), domain and general knowledge, age, and amount of education. Of interest for demonstrating the importance of knowledge in the "information age," positive and significant

correlations were found among knowledge and occupation, income and political activity even when data were statistically adjusted to control for age, education, gender, ethnicity, and measures of extent of literacy practice.

The data from the two telephone surveys using the knowledge assessment checklist methodology indicate that a large amount of information about adults' literacy-related knowledge can be obtained using telephone surveys. But can the information obtained by the telephone survey provide the same range of useful information that was obtained in the door-to-door NALS To answer this question, an *action* or *use* analysis (Messick 1989) of the five informational products that the NALS was commissioned to produce is presented in Part 4 to see how well the telephone data could be used to provide the same or related types of informational products.

Part 3. A Cognitive Theory of Literacy

Kirsch, Jungeblut, and Mosenthal 1998) trace the evolution of the theoretical framework used to construct national and international adult literacy surveys from the 1985 YALS, to the 1992 NALS and the 1995 IALS. Across these surveys, the framework used to develop assessment tasks was based on the types of materials involved in the assessments, the uses that respondents were asked to make of the materials, i.e., the types of tasks performed or questions to be answered, and what Kirsch, Jungeblut, and Mosenthal (1998) refer to as "…three important and distinct areas: prose, document, and quantitative literacy" (106).

In a number of studies, it was found that difficulty of tasks (e.g., percentage getting various items correct) was a function of the information processing complexity of the task, including things like the numbers of items from the questions or task instructions that must be held in mind while searching through materials to locate answers, the amount of materials to be searched or read, or the abstract versus concrete nature of the language in the materials, or the types of and amounts of calculations that had to be done in the quantitative literacy tasks.

But while there are a great deal of empirical data given to support the usefulness of the various material and task variables that the researchers identified through their analyses to predict the difficulty of prose, document and quantitative tasks, there is no explicit discussion of a cognitive theory of the competence (knowledge and skills) that adults must possess to be able to perform the many tasks. For instance, although all of the tasks required the use of reading decoding skills and language-based knowledge, and the prose, document and quantitative scales correlated around +.90, sharing some 80 percent of their variance, there is no theoretical statement about cognition that might account for this large overlap among the three literacy domains.

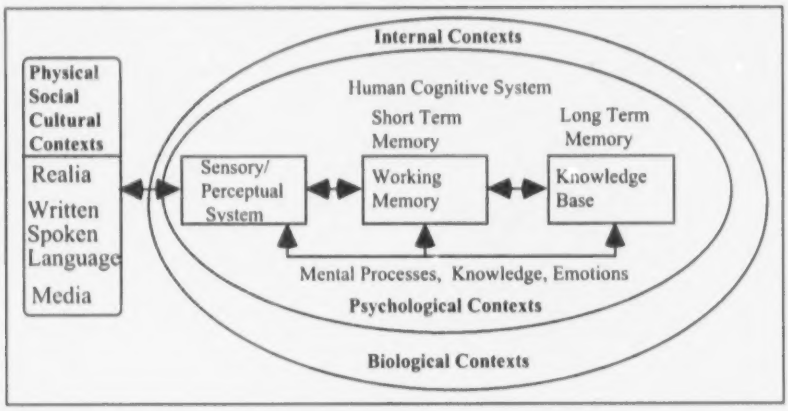
While theories of literacy acquisition vary, including sociolinguistic and sociocultural theories regarding the role of social interactions and cultural practices in the acquisition of literacy (e.g., Reder 1994(b)), the NALS and IALS have been developed based on a cognitive approach (e.g., the "knowledge and skills" needed for Prose, Document and Quantitative scales). Consistent with this conceptual stance, this section of the paper presents a cognitive theory of literacy that explains why there is so much overlap among the prose, document and quantitative scales and how it is possible to focus on different components of literacy to represent different aspects of adults' performance of various literacy tasks. The theoretical framework includes a conception of (1) a simple model of the human cognitive system and (2) a conception of how that system develops from a prelanguage, preliterate system at birth into a language-based, literate system in adulthood.

The Human Cognitive System

The cognitive theory of adult literacy is based on the "modal model of memory" that has been examined in over thirty years of research (Figure 1) (Atkinson and Shiffrin 1971; Healy and McNamara 1996, 143). Generally speaking, highly literate individuals possess large bodies of knowledge in long term memory and information processing capacity and efficiency in working memory to process information in complex graphic documents (Kyllonen and Christal 1990).

Cognitive development is construed as the change in the human cognitive system that results from changes in the anatomy and physiology of the human brain as it grows, develops, and deteriorates in later life. There are three concepts of "context" that are important in understanding cognitive development. Two kinds of context are "inside" the person. One is the biological, physiological context of the body and brain. The second is the mental context of the mind in which the person's psychological life is constructed. The third concept of context refers to the world "outside" the person. This is the physical and social world in which the person lives, the external environment.

Figure 1.—Three components of the human cognitive system.

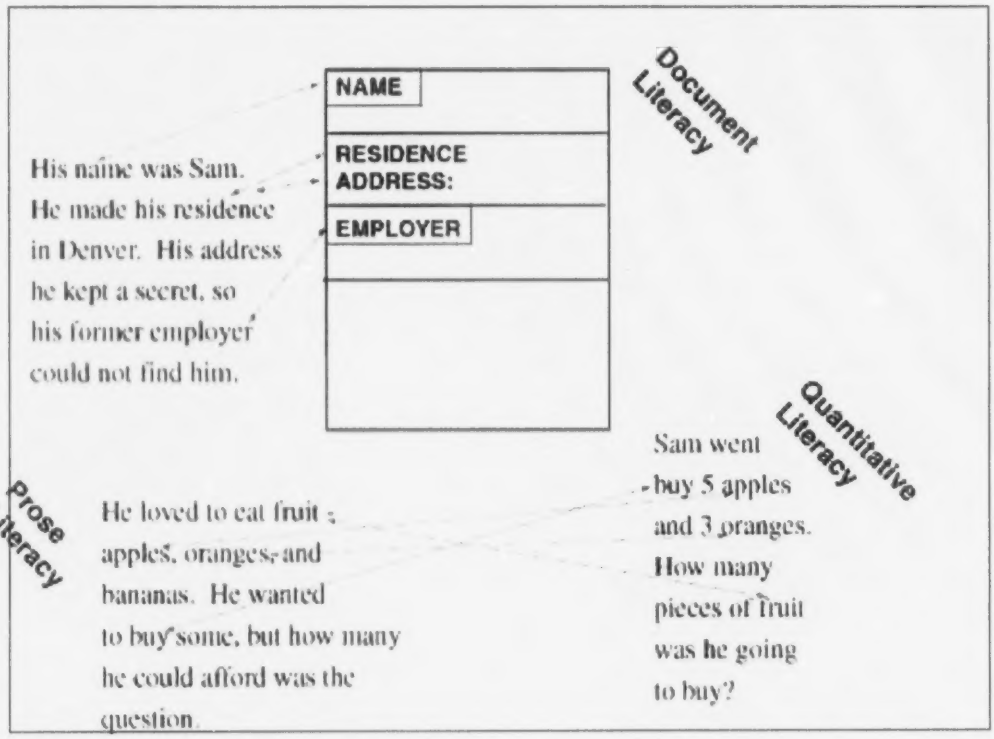


The internal environment or context, which is generally referred to as "mind," is both the result of and the cause of cognitive development through experience. That aspect of mind involved in learning and cognitive development is referred to as the *human cognitive system,* and includes three major components of the cognitive system: the sensory-perceptual system, the short term (or working memory) and the long term memory (or knowledge base). The working memory is where active thinking takes place. Thinking processes lead us to pick up information from the outside environment and the internal knowledge base and combine these two sources of information to construct our understanding of the world at a particular moment. To a large extent, it appears to be the load or strain on working memory that accounts for much of the difficulty that Kirsch, Jungeblut, and Mosenthal (1998) related to the numbers of features that had to be held in mind and matched in the materials of the NALS or IALS, along with the types of calculations that had to be performed in working memory ("mental math") in quantitative tasks.

As the rough sketch below (Figure 2) indicates, a large amount of the overlap among the prose, document and quantitative tasks seems also to reflect the role of the knowledge base that is drawn on in comprehending the interviewer's task instructions and in reading and comprehending the information in all three types of displays of information. As the figure illustrates, the vocabulary used to construct prose displays of information may also be used to construct document and quantitative displays. The extent of the vocabulary knowledge in adults' knowledge bases no doubt contributed to their ability to deal with tasks involving "concrete" or "abstract" language and with larger amounts of information presented in written language. It should be noted that the commonality of language and working memory processes operate in most cognitive assessments, leading to what some have called "general

ability" or "psychometric "g" (Gottfredson 1997). The present cognitive theory goes beyond these concepts by emphasizing the three-part model of the human cognitive system and the multifaceted components of cognitive development given in the developmental model of literacy described below.

Figure 2.—Illustration of how language-represented knowledge from the knowledge base of the human cognitive system model can be used across prose, document and quantitative literacy tasks to produce high correlations among the three literacy scales.


NAME
RESIDENCE ADDRESS:
EMPLOYER
Document Literacy
His name was Sam. He made his residence in Denver. His address he kept a secret, so his former employer could not find him.
Quantitative Literacy
Sam went buy 5 apples and 3 oranges. How many pieces of fruit was he going to buy?
Prose Literacy
He loved to eat fruit : apples, oranges, and bananas. He wanted to buy some, but how many he could afford was the question.

A Developmental Model of Literacy

A major goal of literate societies (and societies seeking literacy) is that each new generation should develop cognitive systems with the knowledge and processing skills needed to use (produce and access) the symbolic knowledge bases stored in the external environment in the form of books, maps, tables, and so forth. For this reason, a schematic representation of cognitive development in the literacy domain is used to organize information about the development of the human cognitive system as it transforms itself from preliterate to literate.

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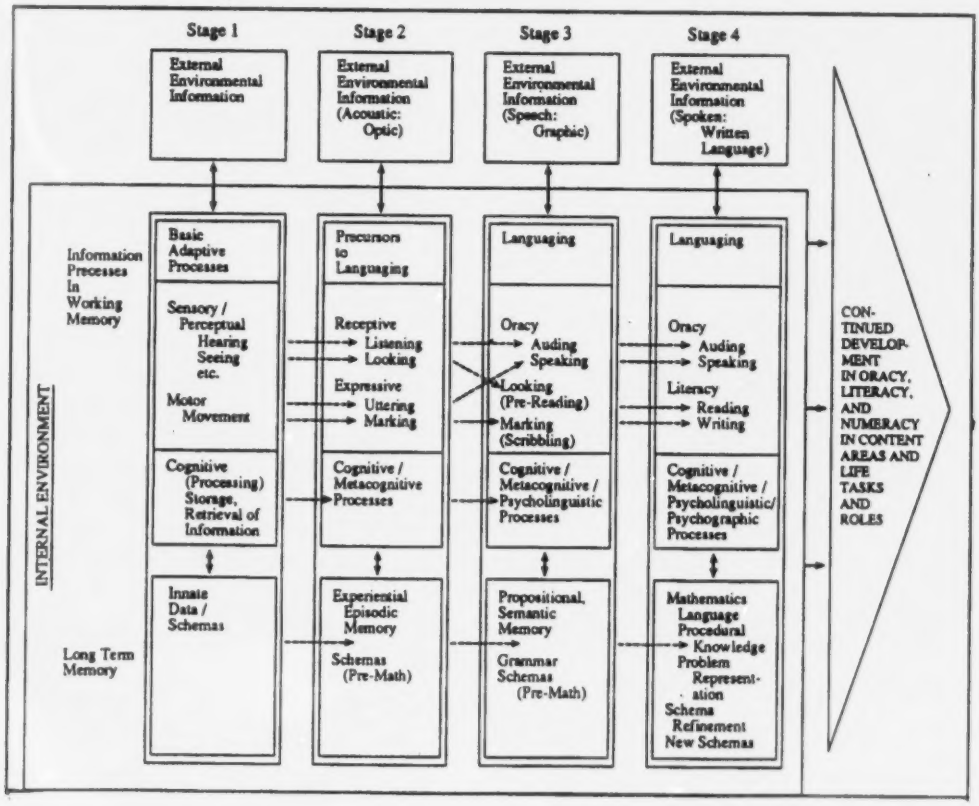
To (hopefully) facilitate understanding, the major concepts used in modeling the development of literacy in "the typical case of a child growing up in our literate society" are presented schematically in Figure 3.

Before addressing the details of the model, several orienting comments regarding the figure are in order. First the figure is meant to portray a developmental sequence when examined from left to right. The sequence begins with the newborn infant (far left), and goes through stage 4 in which literacy skills are functional. The broad arrowhead on the far right is meant to imply continued development over the lifespan. The development of literacy, language, and knowledge is a lifetime activity.

Figure 3.—A Developmental Model of Literacy



Examining the model from top to bottom, the top series of boxes is meant to represent the environment in which the person exists. This is the environment "outside the head." This external environment makes available information displays that the person can explore and transform into internal representations of the external

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information. These internal representations are developed by the processes in the second series of boxes labeled, on the far left, Information Processes in Working Memory. These processes go on "inside the head," and merge information picked up from the external information displays with information picked up from the third series of boxes, labeled on the far left as Long Term Memory. Thus, the processes in the working memory are used to pick up and merge information from outside the body/brain with information in long term memory inside the body/brain to construct an internal representation of the world as currently experienced, including the construction of a meaning represented in symbolic information when this is a major domain of information being extracted from the external world at a given time.

At the top of the model, there are references to four "stages." In the present case, the term "stage" refers to what would typically be observed at different times if one studies children growing up in our literate society. For instance, stage 1 refers to the newborn infant who is considered to be innately endowed with the Basic Adaptive Processes involved in sensory/perceptual processes such as hearing and seeing, etc., motor movement, and cognition, including the processes needed to acquire information, mentally manipulate it, store it in memory, form knowledge structures out of it, retrieve and represent the information in various ways. In stage 1, these processes are assumed to work more or less automatically without conscious control, hence an observer would note that the infant seems "captured" by stimuli, rather than selective in observing information in the world.

Stage 2 represents the emergence of conscious control over information pickup and manipulation. This active process of attending to information distinguishes *listening* from hearing, and *looking* from seeing, as information pick-up processes. Listening and looking build internal representations that may be called *images*. Images may also be constructed from data stored in long term memory. These internal imaging processes are frequently assessed in aptitude tests as "spatial perception" or "mechanical comprehension" in which it is necessary to mentally visualize and rotate cog-and-gear systems to determine what effects this movement might have on some other gear.

Stage 2 also introduces the concept of *active* or *working memory*, which is defined by the occurrence of consciously controlled information processing activities. As noted earlier, working memory is a limited memory that can be easily overloaded (e.g., attending to two or three things at once is difficult—if not impossible). Many of the information processing activities the person acquires will be techniques to overcome active memory limits (e.g., repeating information to oneself keeps the information in active working memory until it can be applied). The "stage" aspect of cognitive development shows itself by the ability of the infant to attend to information selectively.

This is a cognitive capability, which, once developed, is a permanent feature of cognition that distinguishes the stage 2 child from the stage 1 child.

Stage 3 represents the development of language processes out of earlier processes and knowledge stored in long term memory. In developing oral language, the listening process is used in attending to spoken language to learn the words and grammar of language. Thus, listening *plus languaging*, occurs simultaneously. This joint occurrence is given the special name of *auding*. On the production side, the joint occurrence of uttering (making sounds through the mouth) with the production of word forms from the language pool, and stringing the word forms together to make sentences using the rules of syntax, produces the special process called *speaking*. Auding and speaking comprise the oral language information reception and production skills. Speaking is used to represent information that the person has in his or her mind "outside the head" and in the acoustic medium, while auding is used to pick up and transform speech information displays into knowledge in the mind of the listener. To an observer, the stage 3 child can respond to and produce oral language, at least to some minimal degree. Again, as with conscious attending, once oral language has begun to emerge, the cognitive system is permanently modified (barring physiological trauma of some sort), and the person is no longer capable of exclusively prelinguistic modes of thought.

In transitioning to stage 4, the information processing skills of looking and marking are used to learn a representational system which, in many respects, represents the spoken language in a different medium—light-–and in a more or less permanent graphic display: the written language. Looking at written language and transforming the written language into meaning is called *reading*. Writing is the special use of marking skills to produce graphic language (and other symbols and symbol systems).

In the typical case, children develop a fair amount of competence in oral language before they are exposed to formal instruction in reading in elementary grades (though informal learning of literacy may begin in the home and community in literate cultures). In literacy instruction, written language skills build upon the earlier developed oral language skills and add to the person's knowledge base special knowledge about how to represent and comprehend information in the graphic medium that was previously represented and comprehended by the person only in the oral language. Later, learning new vocabulary and conventions of language through reading and writing reflects back on oral language development and enlarges the person's oral language abilities. The large arrow at the far right in Figure 3 is meant to represent the notion that the development of oral and written language ability may continue indefinitely as the person studies and develops new knowledge domains.

A major component of the developmental model of literacy is the person's long term memory or "knowledge base." The long term memory contains all the knowledge developed by the person in interaction with the environment. Much of the knowledge acquired by the person will not be understood in consciousness (for example, the rules of grammar). Rather, it will be unconsciously used to accomplish tasks such as developing language competency and comprehending the events of the world. In addition to the general world knowledge and processes that are in the mind, though not accessible to conscious understanding without considerable analysis, the memory also contains the language knowledge (words and grammar) that can be used to represent information that arises from experience in the world (e.g., bodies of knowledge about machines, parts of the body, houses, neighborhoods—sometimes called "schema" (Bransford et. al. 1986) or "mental models" (Rumelhart,1980), and from didactic instruction, as in training programs.

The model holds that the development of the oracy skills of speaking and listening (auding) are built upon the prior development of prelinguistic knowledge through information processing activities. It is important that it be understood that this early, prelinguistic cognitive content, or knowledge, will form the foundation for the acquisition of new knowledge over the person's lifetime, including that knowledge known as "literacy."

A final aspect of the model is that it recognizes that, on the one hand, the literacy skills of reading and writing utilize the same knowledge base that is used in auding and speaking, plus the special decoding and encoding skills of reading and writing. On the other hand, the very nature of the written language display—characterized by being more or less permanent, being arrayed in space, and utilizing the features of light (color, contrast)—makes possible the development of skills and knowledge entirely different from those involved in oral language.

Literacy and the Merging of Speech and Graphics Technologies

In all societies, preliterate people learn to communicate with others in their communities. One way they do this is by the use of visible movements called gestures. For example, they may make grimaces when food tastes bad to them, or frown when sad, or point to direct other's attention to something.

Another way preliterate people learn to communicate with others is through the development of a form of gesturing that transmits thoughts not by visible means, but by the invisible movement of the molecules of the sea of air in which people are immersed. That is, they acquire the oral language of their community. This means that their brains engage in *a mental design and execution process* that permits them to use their neck and chest muscles, lungs

and oral apparatus (i.e., their *articulators*, tongue, throat, teeth, lips, larynx) and their ears and other auditory components to produce movements (speech gestures) that result in sounds and sequences of sounds that permit them to exchange thoughts with others. The brain engages in this mental process without the person being consciously aware of what the brain is doing or how it is doing it. That is, the actual mechanics of the acquisition of the spoken language is done automatically by the person's brain.

A child's developmental process typically leads to the formulation of a mental (brain) system or component, called *grammar,* consisting of a lexicon (a vocabulary of forms, generally words, though sometimes word-parts, e.g., -ed, constructed by the mental design process that controls the articulators) and a syntax (rules for arranging the word forms into sentences) for conveying meaning through sounds in the air. From their parents, siblings and others in their social group children learn certain formalities or rules about how one talks about certain others, what forms of address to use, how to formulate and tell a narrative story about some event they experience and many other things about the use of their native language.

The Person's Use of the Graphic Medium for Cognition and Communication. In addition to using visual gestures and those involved in speech for communication, preliterate people also learn to use some forms of marking of surfaces as a visual, *graphic* medium of communication. For instance, they may tattoo their bodies with graphic designs having various symbolic meanings. They may weave such designs into blankets or clothes, carve designs on wooden utensils or paint them on pottery.

Though the gesture movements that produce both spoken and graphic designs may be used for communication, the graphic medium has features that differ from speech which permit the user to accomplish cognitive and communication tasks that would not be possible otherwise due to the limits of human memory. These features include *permanence*, *spatiality*, and *light.*

The relative permanence of graphic displays makes possible the storage of information "outside the head" and makes it necessary for others to learn to look at and interpret the graphic "gestures" if they wish to retrieve the stored information. Similarly, the fact that the graphics medium uses space and light makes possible the design of a wide variety of displays that permit preliterate people to perform a number of cognitive and communication tasks that are not possible with the temporally linear, fleeting spoken language.

Literacy as the Merging of Speech and Graphics Technologies. In anthropological terms, *technology* is the body of knowledge a civilization uses to fashion implements, extract or collect materials, or practice various arts and skills (Morris 1976). From this point of view, *literacy* may be thought of as technology for producing and comprehending graphic displays as tools (implements) for accomplishing various cognitive and communication activities (Harris 1986; Goody 1977). In writing, a person "extracts" knowledge from the brain and "collects" (stores) it in graphic displays. Then, through the practice of the skill of reading, the collected knowledge is extracted by the same or another person from the graphic display and reconstructed in the brain.

Much of what is encountered in teaching and learning reading results from the fundamental characteristics of graphics displays. These characteristics permit literates to work with the graphics technology in certain ways. Furthermore, the products of the work of literates create new graphics displays (e.g., history timelines, TV schedules, troubleshooting flow diagrams, atlases). This imposes additional information processing demands upon new readers who wish to learn to work with these new displays.

Major Features of Graphics Technology

The major features of graphics technology, examples of the types of products that may be produced by those in command of the technology, and examples of the types of demands for information processing that the products of this technology may require include:

(1) *Permanence.* Graphic information displays, such as this page of print, or forms, tables , graphs, and so forth, are more or less *permanent.* Therefore, they can be used to collect or store information, including an extended body of knowledge. The information can be stored over time and retrieved later on, and it can be transported across space.

(2) Spatiality. Unlike speech, graphic information displays can be arrayed in space. Signs can be placed on doors, over buildings, alongside highways, and so forth; pages of print with words laid out spatially to permit the recreation of a temporal flow of speech can be constructed; forms can be developed with "slots" containing labels ("Name;" "Address;" etc., see Figure 2, above) and myriad other graphic tools to accomplish various information transmission

and processing tasks can be developed (Schwartz 1971), such as labels, lists, bus schedules; flow charts; tables; schematics; transparencies; and so on.

(3) *Light.* The third major feature of graphics technology that is drawn on in literacy is the use of light. The marks that are made to produce such graphic symbols as written or printed words, numbers, arrowheads in procedural flow charts, the white space of the cells in a table (matrix) and so forth are constructed by structuring the light that leaves the surface of the graphic medium such that the eye can detect the structure in the display.

In addition to aiding in overcoming *memory* limitations and facilitating learning through various semantic "chunking" and organizing devices, the properties of light are extensively used to aid *attention* during information processing. **Bold print** may be used to call attention to certain information and *color* can guide information processing, as when a red line is used in an electronics diagram to permit a particular circuit to be traced in an array of circuits printed in black.

As with all technology, the power of graphics technology arises from its use to develop tools for amplifying and extending human capabilities (Bruner 1968). However, unlike hammers, sewing machines, automobiles, and other technologies that extend human strength, dexterity, or locomotion abilities, graphic technologies gain their power from their application to the extension of human cognition and the ability to manipulate information in symbolic form.

In particular, the merging of graphics technology with spoken language, itself a form of human technology for communicating with symbols, produces the power behind, and the awe and appreciation of, literacy.

The Graphic Representation of Spoken Language

Perhaps the capstone achievement in graphics technology was the development of the *alphabet*, a relatively simple technology by means of which a few graphic marks can represent enough aspects of the oral language that the marks permit a reader to reconstruct an oral language-based message from the graphic display (McGuinness 1997). The importance of this is that it permits graphic language to draw on the power of oral language for representing and

communicating knowledge, while bringing the power of the three features of graphics technology to bear on the development of new knowledge and tools for thinking and problem solving.

For those adults with little or no reading ability, instruction generally centers on *decoding* or reconstructing a spoken message from the graphic display or "code." The written display is called a "code" because it is considered an alternative representation of speech. In a simple substitution code one element in a message, such as the sequence 1, 2, 3 is substituted by another set of symbols, such as a, b, and c. In decoding, then, a is converted to 1, b to 2, and c to 3.

Though such a simple, one-to-one correspondence of speech and graphic symbols does not hold over the full range of the English language, enough correspondence is there to make the technology work. In the teaching of decoding by the *principle of the alphabet* (Liberman, Shankweiler, and Liberman 1989) learners are taught to substitute a graphic alphabet symbol for a speech sound (phonemics; phonics). In teaching writing they are taught to make drawings (alphabet characters) that can, in turn, represent speech sounds.

Discussion. The theoretical model of the human cognitive system given in Figure 1 along with the illustration of Figure 2 suggest that one reason that the prose, document and quantitative tasks of the YALS, NALS, and IALS are so highly correlated is because for any given adult, the item tasks in all three domains draw upon the same long term memory or knowledge base, the same language (vocabulary, syntax) system, the same working memory system, and the same sensory-perceptual system that the adults have developed over their lives as illustrated in Figure 3.

As Figure 2 illustrates, it is possible to separate out the language component of the prose, document and quantitative items from the graphic display components of the tasks. The latter introduce much of the demand for visual search and locate processes that tend to place an increasing load on working memory and renders tasks more difficult.

For many people, as characterized in the developmental model of literacy of Figure 3, reading and writing refers to one's mastery of the alphabetic principle, that is, the idea that speech sounds can be represented in a graphic code called the alphabet and reading is the recoding of the graphic code into a spoken language-based meaning. In fact, the "simple view of reading" (Gough 1996) considers that R=D+C, Reading equals Decoding plus Comprehension, where the latter is measured by listening tests. Recent research has supported the "simple view of reading" (Chen and Vellutino 1997).

The developmental model, the "simple view of reading, " and extensive empirical evidence (Sticht et al. 1974; Sticht, Hooke, and Caylor 1981(a); Sticht and James; 1984; Sinatra; 1990) suggest that once adults get beyond the decoding stage of reading, their comprehension of language can be assessed equally well by listening as by reading (see the Appendix to this paper). All of the studies of the use of telephone surveys demonstrated that they could assess vocabulary knowledge by listening, and these assessments correlated well (r's in the +.80 range) with performance by reading in face-to-face or mail out assessments.

But given that neither the actual reading of language nor the use of graphics displays occurred in the telephone studies reviewed above, the question remains as to whether or not the information obtained by telephone surveys can provide the same range of useful information that was obtained in the door-to-door NALS. This was the question posed earlier in this paper that addresses the *action* or *use* validity (Messick 1989) of the telephone methodology. The answer to this question is discussed next in the context of the analysis of the cost-effectiveness of the telephone survey methodology used by Sticht and associates (Sticht, Hofstetter, and Hofstetter 1996; Hofstetter, Sticht and Hofstetter 1999) in contrast to door-to-door sampling for producing the range of informational products desired by the U.S. Congress when it commissioned the national survey.

Part 4. Issues in the Use of Telephone and Mail Surveys in Assessing Adult Literacy

Regarding the cost of telephone surveys, in addition to sponsoring the collection of academic skill achievement data by direct testing in the United States, the National Center for Education Statistics (NCES) has an office for conducting telephone surveys. According to Dr. Kathryn Chandler of the NCES, costs per interview by telephone are a fraction of the costs of conducting door-to-door interviews (K. Chandler—personal communication, April, 1994). Chandler estimated that a sample of six thousand telephone interviews with adults might easily be achieved for less than $1 million. This suggests that to interview a national representative sample of 13,600 adults, with an oversampling of black and Hispanic households, as was done in the 1992 NALS (Kirsch et al. 1993), the cost would be approximately $2 million or less. This compares to the approximately $10.85 million cost of obtaining the national sample for the NALS.

The concept of *cost-effectiveness* requires that both the *cost* and the *effectiveness* of alternative methods to achieve the same or very similar outcomes be considered. There is no question that the telephone survey methodology is a lower cost approach to interviewing than door-to-door canvassing. Many may, however, question whether the telephone methodology yields inferences that are as valid (useful) for characterizing the literacy of the adult population as those derived from the actual performance of literacy tasks, as in the 1992 NALS. Fortunately, the report of the design of the NALS provides a list of outcomes, uses, or "benefits" that the NALS was intended to provide (Campbell, Kirsch, and Kolstad 1992, pp. 2-3). This makes it possible to conduct an action or use validity analysis to determine if the same or comparable outcomes as were produced by the NALS were also obtained by the telephone survey approach of Sticht, Hofstetter, and Hofstetter (1996).

The following discussion first states a given informational product that the NALS was intended to provide (Campbell, Kirsch, and Kolstad 1992). This is followed by a discussion of what the NALS and the telephone survey method provided for the informational product. The NCES survey design report stated that the NALS would accomplish the following:

(1) *Describe the levels of literacy demonstrated by the total adult population as well as by adults comprising various subgroups, including those targeted as "at risk."*

The NALS developed three groups of tasks called prose, document and quantitative literacy, administered the tasks to samples of adults, and used the tasks to scale both the adults' literacy proficiencies on each of the three scales and the difficulty levels of the tasks using Item Response Theory. The difficulty level of each task was defined as the level of literacy needed to have "... an 80 percent probability of correct response." (Kirsch, et al. 1993, 71). Next, subjects were assigned to one of five literacy levels based on their proficiency scores.

How well do these procedures characterize the literacy skills of adults? First, the rationale for the decision to scale the adults' literacy proficiency using a probability of .80 of being able to perform a given task, when the probability could have been set at 70, 60 or any other percent, was not discussed (Kirsch et al. 1993). As Kolstad has recently noted (Kolstad, 1996; Kolstad, et al. 1998), changes in this percentage clearly change the outcomes of the analyses. Second, the decision to assign people to five levels of literacy proficiency based on their being able to perform 80 percent of the average tasks at a given level means that any competence to perform at higher levels was not "credited" to the adults. For instance, people who scored on average in Level 1 could also perform 50 percent of

Level 2 tasks, 25 percent of the Level 3 tasks, 20 percent of the Level 4 and one in six of the Level 5 tasks. Given these findings, it is difficult to ascertain what the literacy levels of adults "really" are.

The telephone survey methodology also permits people to be assigned to levels based on the knowledge component of literacy. Levels of literacy knowledge can be established using the same methods as in the NALS, or using means and standard deviations to establish level ranges. With this approach, the decisions regarding what probability figures for task performance should be used are eliminated. Further, other available test information based on normal curve statistics, such as the Armed Services Vocational Aptitude Battery (ASVAB), become relevant to interpreting the survey data.

(2) *Characterize the demonstrated literacy skills in terms of demographic and personal background information.*

Major demographic data collected by the NALS have also been collected in telephone surveys. Whether the NALS-type of graphic displays or the telephone knowledge assessments are used, representations of literacy proficiency were positively and consistently related to education, age, ethnicity, income, occupational status, father and mother's education, extent of engagement in literacy practices such as newspaper and magazine reading, and self-ratings of reading and writing abilities. These same relationships have been reported for the last seventy-five years in every major mass assessment of adult "intelligence," "aptitude," or "literacy" (Sticht and Armstrong 1994). These types of demographic/ knowledge/practice data can be obtained at much less cost by telephone surveys.

(3) *Characterize the work force of the country with respect to demonstrated literacy skills and activities reported by individuals in various occupational categories.*

The door-to-door and the telephone surveys both characterize the literacy proficiencies and practices of adults in major occupational groups. Both types of surveys produce similar results: laborers are not as proficient as clerical workers who are not as proficient as managers and professionals. These findings have been consistently found in numerous adult cognitive abilities assessments since the introduction by the U.S. Army of mass testing during World War I (Sticht and Armstrong 1994). The telephone survey method collects occupational data much less expensively than the door-to-door survey method.

(4) *Provide an increased understanding of the skills and knowledge associated with functioning in a technological society.*

Probably the most important question that the NALS researchers were asked to report on was, "Are the literacy skills of America's adults adequate ... to ensure individual opportunities for all adults, to increase worker productivity, or to strengthen America's competitiveness around the world?" (Kirsch et al. 1993, xviii). The NALS report answered the question as, "Because it is impossible to say precisely what literacy skills are essential for individuals to succeed in this or any other society, the results of the National Adult Literacy Survey provide no firm answers to such questions" (Kirsch et al. 1993, xviii). The authors discussed the relation of being in the lower literacy levels to one's social standing as indicated by more limited occupational opportunities, income, and so forth. From this, readers were invited to make inferences about how lower literacy skills may tend to limit one's functioning in society. But all of these same relationships are readily studied by the telephone survey methodology at a lower cost and with fewer decisions having little or no rationale presented.

It might even be argued that the assessment of knowledge (by checklists and/or other methods) is a more useful method for characterizing the "skills and knowledge associated with functioning in a technological society." Several studies have demonstrated that high levels of "prior" or "background" knowledge in a specific domain can compensate for several "years" of "general" reading skill (Recht and Leslie 1988; Sticht et al. 1986). The NALS study itself concluded that high levels of "prior" or "background" knowledge about what one reads is prerequisite for comprehending at a high level across the wide range of tasks in the battery.

For these reasons, it seems likely that assessments of knowledge might better predict the performance of "real world" literacy tasks than the NALS-type scales. As illustrated by the research reviewed above, the Armed Services have spent decades and tens of millions of dollars on the Armed Services Vocational Aptitude Battery (ASVAB), consisting of ten tests, all of which require some reading and eight of which are tests primarily involving general and special vocabulary and conceptual knowledge (e.g., knowledge of geometry, electronics, automobiles, etc.) (Sticht and Armstrong 1994). A composite of four of these knowledge tests forms the Armed Forces Qualification Test (AFQT) used to select applicants for military service. As noted in Part 2 (above), a telephone survey methodology using just vocabulary (word knowledge) assessment was able to estimate the AFQT scores of personnel with just a 10 to 11 item test using an adaptive testing algorithm. Since the AFQT is used to determine one's qualification for military service, this supports the position that knowledge assessment can serve to identify

those who can use printed and written materials to function in society, at least in the high-technology world of the armed services.

(5) *Interpret the findings related to information-processing skills and strategies in a way that can inform curriculum decisions pertaining to the education and training of adults.*

In addition to wanting information about adults' literacy skills, Congress wanted information regarding instructional "remedies" that might be taken to improve adults' literacy skills. The developers of the NALS suggested that adult basic skills programs should be geared to improving adults' skills in prose, document and quantitative (PDQ) literacy (Mosenthal and Kirsch 1994). Indeed, researchers at the Educational Testing Service worked on an interactive video, computer-based instructional series that would teach document literacy skills. A small pilot study with a group of some ten to twelve adult basic skills students indicated that, while students made improvements in document literacy, they made three to four times as much gains on prose and quantitative literacy tests as on the document literacy tests. This led the instructor who administered the pilot course to observe that, "The gains were interesting considering the PDQ curriculum did not include instruction in these skills." (Orr-Holley 1992, 1).

Yet, as noted earlier, the human cognitive system model and the developmental model of literacy suggest that the three scales are not separate areas of competence. Rather, they draw upon the same underlying cognitive system with its knowledge base and working memory processes. For this reason, it is to be expected that many language and processes developed in one domain may be available to other domains because they all draw on the same cognitive system. The results of the pilot instructional program would seem consistent with this point of view.

The research reviewed above adds support to Stanovich's (1993) socially relevant work on the origins of "verbal intelligence." The theory behind the knowledge-based approach to literacy assessment used in the telephone and checklist survey is the practice-engagement theory of literacy development (Reder 1994(b); Stanovich 1993; Krashen 1993). This theory holds that, by engaging in extensive practices involving a wide range of reading, literates build vast bodies of knowledge (both declarative and procedural) and automaticity of word recognition that in turn make it possible to engage in and successfully complete a large number of literacy tasks. This suggests one simple recommendation for curriculum development for adult literacy programs from the telephone and checklist methodology of Sticht, Hofstetter, and Hofstetter (1996) and Hofstetter, Sticht and Hofstetter, (1999). To help people develop large bodies of knowledge and hence to become highly literate, literacy programs should arrange

conditions that will encourage students to engage in extensive, wide-ranging, substantive listening and reading over long periods of time. This seems to be the sort of thing that participation in long term education does.

Sampling and Other Issues

The use of sampling techniques raises questions about how well telephone samples represent the adult population in general, and particular segments in particular. Some may question the validity of the inferences derived from the telephone methodology for accurately representing the literacy of adults because some adults do not have telephones, and they are likely to be the least educated for whom literacy is a major concern. But sampling issues plague all surveys, including the NALS and telephone surveys (Dillman 1978; Frey 1989). Typically, demographic data from the census can be obtained to permit quite accurate extrapolations of telephone estimates to households without telephones and for the least educated. In fact, as noted earlier, the U.S. National Center for Education Statistics already has an office that uses biennial telephone surveys to obtain information about adult education for national policy purposes. The same sampling methods can be used to acquire a representative sample of adults for literacy assessment (K. Chandler—personal communication, April, 1994).

Additionally, special populations in correctional facilities or in adult literacy education programs might be sampled using both face-to-face, paper-and-pencil surveys and telephone surveys to establish correspondences among telephone knowledge- and self-rating-based estimates of literacy.

Another issue is possible public resistance to the telephone methodology for assessing adult literacy because there is no actual reading or writing involved. In this regard, it should be noted that Albert Shanker, late President of the American Federation of Teachers union, devoted his entire Sunday New York Times column of January 14, 1996, to a report on the importance of developing knowledge in the public schools based on the telephone study of Sticht, Hoffstetter, and Hoffstetter (1996). This suggests a degree of popular acceptance of the telephone and checklist methodology for assessing literacy.

Additionally, as the research reviewed indicates, mail surveys may be used along with telephone surveys to make it possible to assess adults' use of written materials and gain acceptance of the telephone methodology for assessing literacy. It is not necessary to limit assessments to the use of the checklist methodology. To avoid the types of criticisms of "cultural imperialism" that faced Hirsch (1987), for instance, a kit of materials might be mailed to a sub-sample of persons contacted by telephone and then an 800 telephone number could be used for the kit recipient

to call in to have a set of directions for performing various tasks with the written materials. Or there could be a call-back time for the telephone test administrator to contact the kit recipient. For instance, if the kit included a small book, then the interviewer might call and ask the respondent to turn to a given page and read a specified sentence aloud or to summarize the main idea of a paragraph. The book could include stories or information representative of many different cultural groups and the same methods used by the NALS, IALS and the forthcoming NAAL for ensuring acceptance by various cultural groups could be used in the design of the book or kit of materials.

If a page of the small book contained a train schedule, then the examiner might ask the respondent the same sort of working memory loaded tasks involved in search and locate questions used with the document items of the NALS.

Additionally, reading-related assessments such as phonemic awareness knowledge might be assessed via telephone using phonemic blending or segmentation tests. With a mail- out kit, the adult might be asked to read aloud a list of pronounceable nonsense "words." Such techniques as the "book comprehension" mail-out and telephone methodology coupled with assessments of decoding skills might be especially useful in generating new information about the instructional needs of adults in NALS/IALS/NAAL Levels 1 and 2.

Of course, if used as a supplement to a decennial adult literacy door-to-door assessment, then a telephone and/or mail-out survey methodology and instruments could provide information that has been correlated with NALS-type items in addition to other, knowledge based items to track adults' literacy during years in between the decennial assessments, perhaps as a part of the NCES regular biennial adult education surveys that are presently conducted. This would couple the telephone methodology with the NAAL methodology and permit the tracking of change over time using the NAAL approach every ten years and the telephone/mail approach in between and every ten years.

This paper was prepared under a contract with the Education Statistics Service Institute (ESSI) with funding from the U.S. Department of Education, National Center for Education Statistics. The opinions and conclusions stated are those of the author and do not necessarily represent the opinions, policies or positions of the ESSI or the U.S. Department of Education, National Center for Education Statistics.

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Appendix

This appendix summarizes an empirical study of the proposition stated on page 20 of the paper that "once adults get beyond the decoding stage of reading, their comprehension of language can be assessed equally well by listening as by reading."

The manual for the Literacy Assessment Battery (LAB) (Sticht, Hooke, and Caylor 1981(b)) includes data showing the results of testing five hundred ninety-three applicants for military service using both the Gates-MacGinitie Reading Test (Level D) and the Listening and Reading Paragraphs subtests of the LAB. The latter was developed for the U.S. Air Force to measure the ability of adults to comprehend language by listening and reading. The LAB includes other components, too, but they are not relevant to the present discussion.

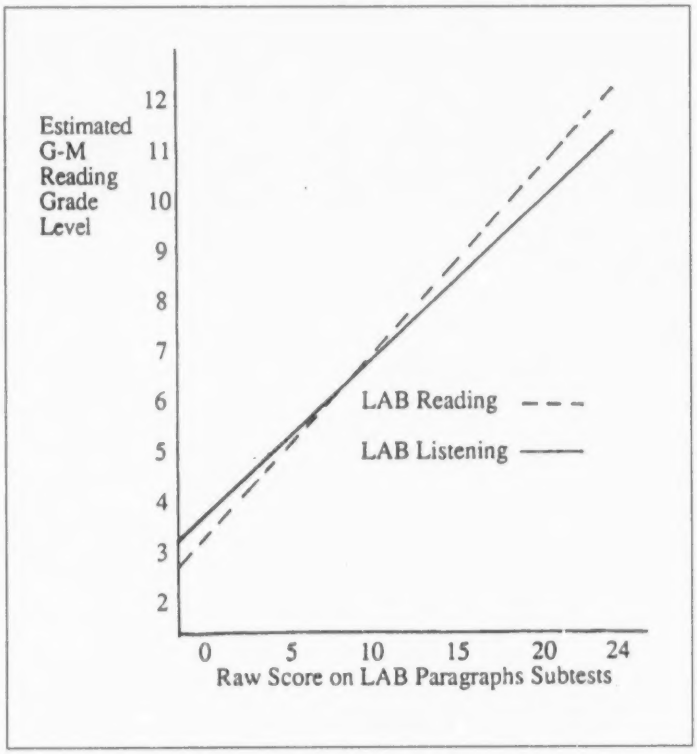
With test scores on the LAB Listening and LAB Reading subtests as well as the G-M reading test, made up of combined vocabulary and paragraph reading subtests, it was possible to develop regression formulas to estimate G-M reading scores from LAB Listening and Reading subtest scores. This permits one approach to determining the extent to which the above proposition is accurate. If it is assumed that the widely used G-M is a valid measure of language comprehension by reading, then the question is, does the LAB Listening subtest estimate G-M reading in a similar manner as the LAB Reading subtest?

A maximum score of 24 points was possible on either the Listening or Reading LAB subtests. The figure shows estimated G-M reading grade levels as a function of raw scores on the LAB paragraph tests for Listening and Reading.

The correlation of LAB Listening with Lab Reading was .749 (56% shared variance). LAB Reading with G-M Reading was .804 (65% shared variance), LAB Listening with G-M Reading was .744 (55% shared variance).

By way of comparison, the G-M correlated with the Nelson Denny Reading test .696 (48% shared variance) for a sample of 1,020 applicants for military service. Thus the LAB Listening subtest was more highly correlated with the G-M reading test than was the Nelson Denny reading test.

The data from the LAB, G-M, and Nelson Denny testing are consistent with the proposition that "once adults get beyond the decoding stage of reading, their comprehension of language can be assessed equally well by listening as by reading."



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No.	Title	NCES contact
Baccalaureate and Beyond (B&B)		
98-15	Development of a Prototype System for Accessing Linked NCES Data	Steven Kaufman
Beginning Postsecondary Students (BPS) Longitudinal Study		
98-11	Beginning Postsecondary Students Longitudinal Study First Follow-up (BPS:96-98) Field Test Report	Aurora D'Amico
98-15	Development of a Prototype System for Accessing Linked NCES Data	Steven Kaufman
1999-15	Projected Postsecondary Outcomes of 1992 High School Graduates	Aurora D'Amico
Common Core of Data (CCD)		
95-12	Rural Education Data User's Guide	Samuel Peng
96-19	Assessment and Analysis of School-Level Expenditures	William J. Fowler, Jr.
97-15	Customer Service Survey: Common Core of Data Coordinators	Lee Hoffman
97-43	Measuring Inflation in Public School Costs	William J. Fowler, Jr.
98-15	Development of a Prototype System for Accessing Linked NCES Data	Steven Kaufman
1999-03	Evaluation of the 1996-97 Nonfiscal Common Core of Data Surveys Data Collection, Processing, and Editing Cycle	Beth Young
Decennial Census School District Project		
95-12	Rural Education Data User's Guide	Samuel Peng
96-04	Census Mapping Project/School District Data Book	Tai Phan
98-07	Decennial Census School District Project Planning Report	Tai Phan
Early Childhood Longitudinal Study (ECLS)		
96-08	How Accurate are Teacher Judgments of Students' Academic Performance?	Jerry West
96-18	Assessment of Social Competence, Adaptive Behaviors, and Approaches to Learning with Young Children	Jerry West
97-24	Formulating a Design for the ECLS: A Review of Longitudinal Studies	Jerry West
97-36	Measuring the Quality of Program Environments in Head Start and Other Early Childhood Programs: A Review and Recommendations for Future Research	Jerry West
1999-01	A Birth Cohort Study: Conceptual and Design Considerations and Rationale	Jerry West
2000-04	Selected Papers on Education Surveys: Papers Presented at the 1998 and 1999 ASA and 1999 AAPOR Meetings	Dan Kasprzyk
Education Finance Statistics Center (EDFIN)		
94-05	Cost-of-Education Differentials Across the States	William J. Fowler, Jr.
96-19	Assessment and Analysis of School-Level Expenditures	William J. Fowler, Jr.
97-43	Measuring Inflation in Public School Costs	William J. Fowler, Jr.
98-04	Geographic Variations in Public Schools' Costs	William J. Fowler, Jr.
1999-16	Measuring Resources in Education: From Accounting to the Resource Cost Model Approach	William J. Fowler, Jr.
High School and Beyond (HS&B)		
95-12	Rural Education Data User's Guide	Samuel Peng
1999-05	Procedures Guide for Transcript Studies	Dawn Nelson
1999-06	1998 Revision of the Secondary School Taxonomy	Dawn Nelson
HS Transcript Studies		
1999-05	Procedures Guide for Transcript Studies	Dawn Nelson
1999-06	1998 Revision of the Secondary School Taxonomy	Dawn Nelson

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International Adult Literacy Survey (IALS)		
97-33	Adult Literacy: An International Perspective	Marilyn Binkley
Integrated Postsecondary Education Data System (IPEDS)		
97-27	Pilot Test of IPEDS Finance Survey	Peter Stowe
98-15	Development of a Prototype System for Accessing Linked NCES Data	Steven Kaufman
National Assessment of Adult Literacy (NAAL)		
98-17	Developing the National Assessment of Adult Literacy: Recommendations from Stakeholders	Sheida White
1999-09a	1992 National Adult Literacy Survey: An Overview	Alex Sedlacek
1999-09b	1992 National Adult Literacy Survey: Sample Design	Alex Sedlacek
1999-09c	1992 National Adult Literacy Survey: Weighting and Population Estimates	Alex Sedlacek
1999-09d	1992 National Adult Literacy Survey: Development of the Survey Instruments	Alex Sedlacek
1999-09e	1992 National Adult Literacy Survey: Scaling and Proficiency Estimates	Alex Sedlacek
1999-09f	1992 National Adult Literacy Survey: Interpreting the Adult Literacy Scales and Literacy Levels	Alex Sedlacek
1999-09g	1992 National Adult Literacy Survey: Literacy Levels and the Response Probability Convention	Alex Sedlacek
2000-05	Secondary Statistical Modeling With the National Assessment of Adult Literacy: Implications for the Design of the Background Questionnaire	Sheida White
2000-06	Using Telephone and Mail Surveys as a Supplement or Alternative to Door-to-Door Surveys in the Assessment of Adult Literacy	Sheida White
National Assessment of Educational Progress (NAEP)		
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97-29	Can State Assessment Data be Used to Reduce State NAEP Sample Sizes?	Steven Gorman
97-30	ACT's NAEP Redesign Project: Assessment Design is the Key to Useful and Stable Assessment Results	Steven Gorman
97-31	NAEP Reconfigured: An Integrated Redesign of the National Assessment of Educational Progress	Steven Gorman
97-32	Innovative Solutions to Intractable Large Scale Assessment (Problem 2: Background Questionnaires)	Steven Gorman
97-37	Optimal Rating Procedures and Methodology for NAEP Open-ended Items	Steven Gorman
97-44	Development of a SASS 1993-94 School-Level Student Achievement Subfile: Using State Assessments and State NAEP, Feasibility Study	Michael Ross
98-15	Development of a Prototype System for Accessing Linked NCES Data	Steven Kaufman
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National Education Longitudinal Study of 1988 (NELS:88)		
95-04	National Education Longitudinal Study of 1988: Second Follow-up Questionnaire Content Areas and Research Issues	Jeffrey Owings
95-05	National Education Longitudinal Study of 1988: Conducting Trend Analyses of NLS-72, HS&B, and NELS:88 Seniors	Jeffrey Owings
95-06	National Education Longitudinal Study of 1988: Conducting Cross-Cohort Comparisons Using HS&B, NAEP, and NELS:88 Academic Transcript Data	Jeffrey Owings
95-07	National Education Longitudinal Study of 1988: Conducting Trend Analyses HS&B and NELS:88 Sophomore Cohort Dropouts	Jeffrey Owings
95-12	Rural Education Data User's Guide	Samuel Peng
95-14	Empirical Evaluation of Social, Psychological, & Educational Construct Variables Used in NCES Surveys	Samuel Peng
96-03	National Education Longitudinal Study of 1988 (NELS:88) Research Framework and Issues	Jeffrey Owings
98-06	National Education Longitudinal Study of 1988 (NELS:88) Base Year through Second Follow-Up: Final Methodology Report	Ralph Lee
98-09	High School Curriculum Structure: Effects on Coursetaking and Achievement in Mathematics for High School Graduates—An Examination of Data from the National Education Longitudinal Study of 1988	Jeffrey Owings

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National Household Education Survey (NHES)		
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96-20	1991 National Household Education Survey (NHES:91) Questionnaires: Screener, Early Childhood Education, and Adult Education	Kathryn Chandler
96-21	1993 National Household Education Survey (NHES:93) Questionnaires: Screener, School Readiness, and School Safety and Discipline	Kathryn Chandler
96-22	1995 National Household Education Survey (NHES:95) Questionnaires: Screener, Early Childhood Program Participation, and Adult Education	Kathryn Chandler
96-29	Undercoverage Bias in Estimates of Characteristics of Adults and 0- to 2-Year-Olds in the 1995 National Household Education Survey (NHES:95)	Kathryn Chandler
96-30	Comparison of Estimates from the 1995 National Household Education Survey (NHES:95)	Kathryn Chandler
97-02	Telephone Coverage Bias and Recorded Interviews in the 1993 National Household Education Survey (NHES:93)	Kathryn Chandler
97-03	1991 and 1995 National Household Education Survey Questionnaires: NHES:91 Screener, NHES:91 Adult Education, NHES:95 Basic Screener, and NHES:95 Adult Education	Kathryn Chandler
97-04	Design, Data Collection, Monitoring, Interview Administration Time, and Data Editing in the 1993 National Household Education Survey (NHES:93)	Kathryn Chandler
97-05	Unit and Item Response, Weighting, and Imputation Procedures in the 1993 National Household Education Survey (NHES:93)	Kathryn Chandler
97-06	Unit and Item Response, Weighting, and Imputation Procedures in the 1995 National Household Education Survey (NHES:95)	Kathryn Chandler
97-08	Design, Data Collection, Interview Timing, and Data Editing in the 1995 National Household Education Survey	Kathryn Chandler
97-19	National Household Education Survey of 1995: Adult Education Course Coding Manual .	Peter Stowe
97-20	National Household Education Survey of 1995: Adult Education Course Code Merge Files User's Guide	Peter Stowe
97-25	1996 National Household Education Survey (NHES:96) Questionnaires: Screener/Household and Library, Parent and Family Involvement in Education and Civic Involvement, Youth Civic Involvement, and Adult Civic Involvement	Kathryn Chandler
97-28	Comparison of Estimates in the 1996 National Household Education Survey	Kathryn Chandler
97-34	Comparison of Estimates from the 1993 National Household Education Survey	Kathryn Chandler
97-35	Design, Data Collection, Interview Administration Time, and Data Editing in the 1996 National Household Education Survey	Kathryn Chandler
97-38	Reinterview Results for the Parent and Youth Components of the 1996 National Household Education Survey	Kathryn Chandler
97-39	Undercoverage Bias in Estimates of Characteristics of Households and Adults in the 1996 National Household Education Survey	Kathryn Chandler
97-40	Unit and Item Response Rates, Weighting, and Imputation Procedures in the 1996 National Household Education Survey	Kathryn Chandler
98-03	Adult Education in the 1990s: A Report on the 1991 National Household Education Survey	Peter Stowe
98-10	Adult Education Participation Decisions and Barriers: Review of Conceptual Frameworks and Empirical Studies	Peter Stowe
National Longitudinal Study of the High School Class of 1972 (NLS-72)		
95-12	Rural Education Data User's Guide	Samuel Peng
National Postsecondary Student Aid Study (NPSAS)		
96-17	National Postsecondary Student Aid Study: 1996 Field Test Methodology Report	Andrew G. Malizio

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National Study of Postsecondary Faculty (NSOPF)		
97-26	Strategies for Improving Accuracy of Postsecondary Faculty Lists	Linda Zimbler
98-15	Development of a Prototype System for Accessing Linked NCES Data	Steven Kaufman
2000-01	1999 National Study of Postsecondary Faculty (NSOPF:99) Field Test Report	Linda Zimbler
Private School Universe Survey (PSS)		
95-16	Intersurvey Consistency in NCES Private School Surveys	Steven Kaufman
95-17	Estimates of Expenditures for Private K-12 Schools	Stephen Broughman
96-16	Strategies for Collecting Finance Data from Private Schools	Stephen Broughman
96-26	Improving the Coverage of Private Elementary-Secondary Schools	Steven Kaufman
96-27	Intersurvey Consistency in NCES Private School Surveys for 1993-94	Steven Kaufman
97-07	The Determinants of Per-Pupil Expenditures in Private Elementary and Secondary Schools: An Exploratory Analysis	Stephen Broughman
97-22	Collection of Private School Finance Data: Development of a Questionnaire	Stephen Broughman
98-15	Development of a Prototype System for Accessing Linked NCES Data	Steven Kaufman
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Recent College Graduates (RCG)		
98-15	Development of a Prototype System for Accessing Linked NCES Data	Steven Kaufman
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94-01	Schools and Staffing Survey (SASS) Papers Presented at Meetings of the American Statistical Association	Dan Kasprzyk
94-02	Generalized Variance Estimate for Schools and Staffing Survey (SASS)	Dan Kasprzyk
94-03	1991 Schools and Staffing Survey (SASS) Reinterview Response Variance Report	Dan Kasprzyk
94-04	The Accuracy of Teachers' Self-reports on their Postsecondary Education: Teacher Transcript Study, Schools and Staffing Survey	Dan Kasprzyk
94-06	Six Papers on Teachers from the 1990-91 Schools and Staffing Survey and Other Related Surveys	Dan Kasprzyk
95-01	Schools and Staffing Survey: 1994 Papers Presented at the 1994 Meeting of the American Statistical Association	Dan Kasprzyk
95-02	QED Estimates of the 1990-91 Schools and Staffing Survey: Deriving and Comparing QED School Estimates with CCD Estimates	Dan Kasprzyk
95-03	Schools and Staffing Survey: 1990-91 SASS Cross-Questionnaire Analysis	Dan Kasprzyk
95-08	CCD Adjustment to the 1990-91 SASS: A Comparison of Estimates	Dan Kasprzyk
95-09	The Results of the 1993 Teacher List Validation Study (TLVS)	Dan Kasprzyk
95-10	The Results of the 1991-92 Teacher Follow-up Survey (TFS) Reinterview and Extensive Reconciliation	Dan Kasprzyk
95-11	Measuring Instruction, Curriculum Content, and Instructional Resources: The Status of Recent Work	Sharon Bobbitt & John Ralph
95-12	Rural Education Data User's Guide	Samuel Peng
95-14	Empirical Evaluation of Social, Psychological, & Educational Construct Variables Used in NCES Surveys	Samuel Peng
95-15	Classroom Instructional Processes: A Review of Existing Measurement Approaches and Their Applicability for the Teacher Follow-up Survey	Sharon Bobbitt
95-16	Intersurvey Consistency in NCES Private School Surveys	Steven Kaufman
95-18	An Agenda for Research on Teachers and Schools: Revisiting NCES' Schools and Staffing Survey	Dan Kasprzyk
96-01	Methodological Issues in the Study of Teachers' Careers: Critical Features of a Truly Longitudinal Study	Dan Kasprzyk
96-02	Schools and Staffing Survey (SASS): 1995 Selected papers presented at the 1995 Meeting of the American Statistical Association	Dan Kasprzyk
96-05	Cognitive Research on the Teacher Listing Form for the Schools and Staffing Survey	Dan Kasprzyk
96-06	The Schools and Staffing Survey (SASS) for 1998-99: Design Recommendations to Inform Broad Education Policy	Dan Kasprzyk
96-07	Should SASS Measure Instructional Processes and Teacher Effectiveness?	Dan Kasprzyk
96-09	Making Data Relevant for Policy Discussions: Redesigning the School Administrator Questionnaire for the 1998-99 SASS	Dan Kasprzyk
96-10	1998-99 Schools and Staffing Survey: Issues Related to Survey Depth	Dan Kasprzyk

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96-11	Towards an Organizational Database on America's Schools: A Proposal for the Future of SASS, with comments on School Reform, Governance, and Finance	Dan Kasprzyk
96-12	Predictors of Retention, Transfer, and Attrition of Special and General Education Teachers: Data from the 1989 Teacher Followup Survey	Dan Kasprzyk
96-15	Nested Structures: District-Level Data in the Schools and Staffing Survey	Dan Kasprzyk
96-23	Linking Student Data to SASS: Why, When, How	Dan Kasprzyk
96-24	National Assessments of Teacher Quality	Dan Kasprzyk
96-25	Measures of Inservice Professional Development: Suggested Items for the 1998-1999 Schools and Staffing Survey	Dan Kasprzyk
96-28	Student Learning, Teaching Quality, and Professional Development: Theoretical Linkages, Current Measurement, and Recommendations for Future Data Collection	Mary Rollefson
97-01	Selected Papers on Education Surveys: Papers Presented at the 1996 Meeting of the American Statistical Association	Dan Kasprzyk
97-07	The Determinants of Per-Pupil Expenditures in Private Elementary and Secondary Schools: An Exploratory Analysis	Stephen Broughman
97-09	Status of Data on Crime and Violence in Schools: Final Report	Lee Hoffman
97-10	Report of Cognitive Research on the Public and Private School Teacher Questionnaires for the Schools and Staffing Survey 1993-94 School Year	Dan Kasprzyk
97-11	International Comparisons of Inservice Professional Development	Dan Kasprzyk
97-12	Measuring School Reform: Recommendations for Future SASS Data Collection	Mary Rollefson
97-14	Optimal Choice of Periodicities for the Schools and Staffing Survey: Modeling and Analysis	Steven Kaufman
97-18	Improving the Mail Return Rates of SASS Surveys: A Review of the Literature	Steven Kaufman
97-22	Collection of Private School Finance Data: Development of a Questionnaire	Stephen Broughman
97-23	Further Cognitive Research on the Schools and Staffing Survey (SASS) Teacher Listing Form	Dan Kasprzyk
97-41	Selected Papers on the Schools and Staffing Survey: Papers Presented at the 1997 Meeting of the American Statistical Association	Steve Kaufman
97-42	Improving the Measurement of Staffing Resources at the School Level: The Development of Recommendations for NCES for the Schools and Staffing Survey (SASS)	Mary Rollefson
97-44	Development of a SASS 1993-94 School-Level Student Achievement Subfile: Using State Assessments and State NAEP, Feasibility Study	Michael Ross
98-01	Collection of Public School Expenditure Data: Development of a Questionnaire	Stephen Broughman
98-02	Response Variance in the 1993-94 Schools and Staffing Survey: A Reinterview Report	Steven Kaufman
98-04	Geographic Variations in Public Schools' Costs	William J. Fowler, Jr.
98-05	SASS Documentation: 1993-94 SASS Student Sampling Problems; Solutions for Determining the Numerators for the SASS Private School (3B) Second-Stage Factors	Steven Kaufman
98-08	The Redesign of the Schools and Staffing Survey for 1999-2000: A Position Paper	Dan Kasprzyk
98-12	A Bootstrap Variance Estimator for Systematic PPS Sampling	Steven Kaufman
98-13	Response Variance in the 1994-95 Teacher Follow-up Survey	Steven Kaufman
98-14	Variance Estimation of Imputed Survey Data	Steven Kaufman
98-15	Development of a Prototype System for Accessing Linked NCES Data	Steven Kaufman
98-16	A Feasibility Study of Longitudinal Design for Schools and Staffing Survey	Stephen Broughman
1999-02	Tracking Secondary Use of the Schools and Staffing Survey Data: Preliminary Results	Dan Kasprzyk
1999-04	Measuring Teacher Qualifications	Dan Kasprzyk
1999-07	Collection of Resource and Expenditure Data on the Schools and Staffing Survey	Stephen Broughman
1999-08	Measuring Classroom Instructional Processes: Using Survey and Case Study Fieldtest Results to Improve Item Construction	Dan Kasprzyk
1999-10	What Users Say About Schools and Staffing Survey Publications	Dan Kasprzyk
1999-12	1993-94 Schools and Staffing Survey: Data File User's Manual, Volume III: Public-Use Codebook	Kerry Gruber
1999-13	1993-94 Schools and Staffing Survey: Data File User's Manual, Volume IV: Bureau of Indian Affairs (BIA) Restricted-Use Codebook	Kerry Gruber
1999-14	1994-95 Teacher Followup Survey: Data File User's Manual, Restricted-Use Codebook	Kerry Gruber
1999-17	Secondary Use of the Schools and Staffing Survey Data	Susan Wiley
2000-04	Selected Papers on Education Surveys: Papers Presented at the 1998 and 1999 ASA and 1999 AAPOR Meetings	Dan Kasprzyk

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96-14	The 1995 National Household Education Survey: Reinterview Results for the Adult Education Component	Steven Kaufman
96-20	1991 National Household Education Survey (NHES:91) Questionnaires: Screener, Early Childhood Education, and Adult Education	Kathryn Chandler
96-22	1995 National Household Education Survey (NHES:95) Questionnaires: Screener, Early Childhood Program Participation, and Adult Education	Kathryn Chandler
98-03	Adult Education in the 1990s: A Report on the 1991 National Household Education Survey	Peter Stowe
98-10	Adult Education Participation Decisions and Barriers: Review of Conceptual Frameworks and Empirical Studies	Peter Stowe
1999-11	Data Sources on Lifelong Learning Available from the National Center for Education Statistics	Lisa Hudson
Adult literacy—see Literacy of adults		
American Indian – education		
1999-13	1993-94 Schools and Staffing Survey: Data File User's Manual, Volume IV: Bureau of Indian Affairs (BIA) Restricted-Use Codebook	Kerry Gruber
Assessment/achievement		
95-12	Rural Education Data User's Guide	Samuel Peng
95-13	Assessing Students with Disabilities and Limited English Proficiency	James Houser
97-29	Can State Assessment Data be Used to Reduce State NAEP Sample Sizes?	Larry Ogle
97-30	ACT's NAEP Redesign Project: Assessment Design is the Key to Useful and Stable Assessment Results	Larry Ogle
97-31	NAEP Reconfigured: An Integrated Redesign of the National Assessment of Educational Progress	Larry Ogle
97-32	Innovative Solutions to Intractable Large Scale Assessment (Problem 2: Background Questions)	Larry Ogle
97-37	Optimal Rating Procedures and Methodology for NAEP Open-ended Items	Larry Ogle
97-44	Development of a SASS 1993-94 School-Level Student Achievement Subfile: Using State Assessments and State NAEP, Feasibility Study	Michael Ross
98-09	High School Curriculum Structure: Effects on Coursetaking and Achievement in Mathematics for High School Graduates—An Examination of Data from the National Education Longitudinal Study of 1988	Jeffrey Owings
Beginning students in postsecondary education		
98-11	Beginning Postsecondary Students Longitudinal Study First Follow-up (BPS:96-98) Field Test Report	Aurora D'Amico
Civic participation		
97-25	1996 National Household Education Survey (NHES:96) Questionnaires: Screener/Household and Library, Parent and Family Involvement in Education and Civic Involvement, Youth Civic Involvement, and Adult Civic Involvement	Kathryn Chandler
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95-14	Empirical Evaluation of Social, Psychological, & Educational Construct Variables Used in NCES Surveys	Samuel Peng
Cost of education indices		
94-05	Cost-of-Education Differentials Across the States	William J. Fowler, Jr.
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95-12	Rural Education Data User's Guide	Samuel Peng

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98-09	High School Curriculum Structure: Effects on Coursetaking and Achievement in Mathematics for High School Graduates—An Examination of Data from the National Education Longitudinal Study of 1988	Jeffrey Owings
1999-05	Procedures Guide for Transcript Studies	Dawn Nelson
1999-06	1998 Revision of the Secondary School Taxonomy	Dawn Nelson
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97-09	Status of Data on Crime and Violence in Schools: Final Report	Lee Hoffman
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95-11	Measuring Instruction, Curriculum Content, and Instructional Resources: The Status of Recent Work	Sharon Bobbitt & John Ralph
98-09	High School Curriculum Structure: Effects on Coursetaking and Achievement in Mathematics for High School Graduates—An Examination of Data from the National Education Longitudinal Study of 1988	Jeffrey Owings
Customer service		
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2000-02	Coordinating NCES Surveys: Options, Issues, Challenges, and Next Steps	Valena Plisko
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97-13	Improving Data Quality in NCES: Database-to-Report Process	Susan Ahmed
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98-01	Collection of Public School Expenditure Data: Development of a Questionnaire	Stephen Broughman
1999-07	Collection of Resource and Expenditure Data on the Schools and Staffing Survey	Stephen Broughman
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96-16	Strategies for Collecting Finance Data from Private Schools	Stephen Broughman
97-07	The Determinants of Per-Pupil Expenditures in Private Elementary and Secondary Schools: An Exploratory Analysis	Stephen Broughman
97-22	Collection of Private School Finance Data: Development of a Questionnaire	Stephen Broughman
1999-07	Collection of Resource and Expenditure Data on the Schools and Staffing Survey	Stephen Broughman
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1999-08	Measuring Classroom Instructional Processes: Using Survey and Case Study Field Test Results to Improve Item Construction	Dan Kasprzyk
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97-11	International Comparisons of Inservice Professional Development	Dan Kasprzyk
97-16	International Education Expenditure Comparability Study: Final Report, Volume I	Shelley Burns
97-17	International Education Expenditure Comparability Study: Final Report, Volume II, Quantitative Analysis of Expenditure Comparability	Shelley Burns
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94-07	Data Comparability and Public Policy: New Interest in Public Library Data Papers Presented at Meetings of the American Statistical Association	Carrol Kindel
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95-13	Assessing Students with Disabilities and Limited English Proficiency	James Houser

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1999-09a	1992 National Adult Literacy Survey: An Overview	Alex Sedlacek
1999-09b	1992 National Adult Literacy Survey: Sample Design	Alex Sedlacek
1999-09c	1992 National Adult Literacy Survey: Weighting and Population Estimates	Alex Sedlacek
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1999-11	Data Sources on Lifelong Learning Available from the National Center for Education Statistics	Lisa Hudson
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